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Effectiveness of Ergonomic Training in Reducing Musculoskeletal Disorders Among Farmers: An Agricultural Nursing Program

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Abstract

Background: Musculoskeletal disorders (MSDs) represent a major occupational health concern among agricultural workers in Indonesia. These conditions commonly arise from repetitive workloads, awkward or non-ergonomic body positions, and insufficient understanding of ergonomic practices. As a result, farmers may experience ongoing discomfort, reduced work capacity, and a decline in overall well-being.
Objective: The purpose of this study was to assess the effectiveness of an Ergonomics Exercise Program (EEP) in alleviating musculoskeletal complaints among farmers.
Methods: This study applied a pre- and post-intervention design involving 85 farmers. Symptoms related to musculoskeletal disorders were evaluated before and after the intervention using the Visual Analog Scale (VAS) and the Nordic Body Map (NBM). The Ergonomics Exercise Program was carried out over a two-week period, with participants performing 10-minute exercise sessions each day prior to starting work. The intervention focused on flexibility training, strengthening of core muscles, and correction of working posture. Changes in MSD symptoms were analyzed statistically to determine the effect of the program.
Results: Before the intervention, 54% of participants reported mild pain, while 46% experienced moderate pain levels. The most commonly affected body areas included the calves (62.3%), lower back (45.8%), arms (40%), and shoulders (28.2%). Following the implementation of the Ergonomics Exercise Program, a statistically significant reduction in musculoskeletal complaints was observed ($p < 0.05$), particularly in the lower back, shoulders, and calves.
Conclusion: The findings indicate that the Ergonomics Exercise Program effectively reduced musculoskeletal disorder symptoms among farmers. Incorporating ergonomics-based exercise routines into agricultural nursing and occupational health initiatives may offer a practical and sustainable approach to improving worker health and preventing MSDs in rural farming populations in Indonesia.

Keywords: Ergonomics-based exercise; Farmers; Musculoskeletal disorders; Nordic Body Map; Occupational health; Visual Analog Scale

INTRODUCTION

In Indonesia, farmers represent a workforce that is particularly vulnerable to musculoskeletal complaints. This vulnerability is largely linked to limited application of ergonomic principles in agricultural tasks, which often involve repetitive movements, awkward working positions, and physically demanding workloads (1,2). Previous studies have shown that the prevalence of MSDs among farmers reaches 60-80%, with the most commonly affected areas being the lower back,

shoulders, and feet (3). This condition not only reduces productivity but also impacts workers' quality of life (4,5).

One effective approach to reducing MSDs complaints is through ergonomic exercises. These exercises are designed to improve flexibility, muscle strength, and postural awareness, thereby reducing the risk of injury (6). Several studies have proven the benefits of ergonomic exercises for farmers, such as a 35% reduction in back pain after a structured exercise program (7).

Previous research shows that among rice farmers in Karawang, approximately 98% of respondents reported lower back pain and 95% reported neck pain due to non-ergonomic work postures, which were categorized as high risk using the RULA and Nordic Body Map methods (8). A one group pre-post study in Yogyakarta on sanitation workers reported a decrease in Nordic Body Map scores from 45.11 to 39.16 ($p = 0.000$) after performing 5–10 minutes of ergonomic exercises three times a week (9,10).

Research focusing on farming communities in Indonesia, especially studies that apply nursing-based interventions, remains scarce. This study addresses that limitation by designing and implementing a nursing-oriented ergonomics exercise program tailored to farmers, who represent a population with elevated occupational health risks. The intervention is intended not only to improve physical conditions through structured ergonomic movements but also to incorporate an educational component grounded in nursing-based occupational health promotion, an approach that has received little attention in prior research. The ergonomics exercise program will be introduced directly within the farming community to evaluate its effectiveness in reducing work-related health complaints.

METHODS

Research Design

This research employed a quasi-experimental approach using a single-group pre-intervention and post-intervention design to assess changes before and after the treatment (11).

Population and Sample

The sample in this study consisted of 85 farmers engaged in rice farming, horticulture (flowers / ornamental trees), and vegetables in Cihideung Village, Bandung, West Java, Indonesia. The sampling technique used purposive sampling, with the following inclusion criteria: (1) working as active farmers, (2) experiencing MSDs complaints, (3) willing to be respondents, and (4) able to follow the training provided (12). The approval and ethical clearance from the Ethics Committee STIKep PPNI Jabar was attained upon commencement of the study (Reference No.: III/095/KEPK-SLE/STIKEP/PPNI/JABAR/VIII/2025) at May 6th, 2025.

Research Procedure

This research began with a preparation phase, which involved obtaining permits from the village authorities and coordinating with the farmer group leaders. Screening was conducted to identify respondents who met inclusion and exclusion criteria, followed by an initial measurement of MSD complaints (pre-test) using a questionnaire. The intervention phase involved 85 farmers who received education about musculoskeletal disorders and the objectives of the Ergonomic Exercise Program (EEP), followed by stretching, muscle strengthening, and posture correction exercises relevant to farming activities. The exercises were conducted daily for two weeks, each lasting 10 minutes before work, with monitoring twice a week and daily reporting by the group leader. After the intervention, MSD complaints were measured again (post-test) using the same instrument, and the pre- and post-test results were analyzed using SPSS to assess the effectiveness of the EEP in reducing MSDs.

Instrument

Data collection related to respondent characteristics and MSDs complaints was conducted using the Nordic Body Map (NBM) (13)and the Numeric Rating Scale (NRS) translated into Indonesian (14), and tested in the pre-test and post-test stages. The NBM is a body map that divides the body into several areas, such as the neck, shoulders, upper back, lower back, waist/buttocks, wrists, hands, elbows, knees, and heels/feet, to identify the location of pain or discomfort. Meanwhile, the NRS is used to measure pain intensity on a scale of 0–10, where 0 indicates no pain and 10 indicates the most severe pain.

Data Analysis

Data were calculated using SPSS (Statistical Package for the Social Sciences) version 29 for univariate analysis and paired t-test to see the differences before and after the intervention.

RESULTS

Demographic Characteristics of Respondents

Table 1 presents the demographic and occupational characteristics of the respondents. Among the 85 farmers involved in the study, the majority were male, accounting for 71 individuals (83.5%). Most participants were in the middle-age category (41–60 years), with 63 respondents (74.1%) falling within this range. Regarding educational attainment, primary school education was the most common level, reported by 31 respondents (36.5%).

In Cihideung Village, farming activities were predominantly focused on ornamental plants, with 78.8% of respondents engaged in this sector. The types of crops cultivated included ornamental foliage plants, such as pine, as well as flowering plants, including roses. In terms of work experience, many respondents reported long durations of farming activity, with 28.2% having worked for 21–40 years. This extended period of continuous physical labor may increase vulnerability to musculoskeletal disorders due to prolonged exposure to repetitive and physically demanding tasks.

Frequency Distribution of Pain Locations

Table 2. shows the results of the Nordic Body Map (NBM) questionnaire, showing the distribution of body parts most frequently complained about regarding MSDs. Of the 85 respondents, the most common complaint was pain in the left leg (62.3%). Furthermore, complaints were also quite common in the waist (45.8%) and left arm (40%).

Pain Scale Before and After Ergonomic Exercises Program

Table 3. explains the calculation results of the Numeric Rating Scale (NRS) questionnaire that there was a decrease in the average pain scale of respondents after ergonomic exercise, with an average pain scale before the intervention (pre-test) of 3.61 (SD = 2.099) on a scale of 1–9, while after the intervention (post-test) there was a decrease to 2.01 (SD = 1.443) on a scale of 0–7. (With an explanation of the interpretation: if the scale is 0: No pain/complaint, scale 1-3: Mild pain/complaint, scale 4-6: Moderate pain/complaint, scale 7-9: Severe pain/complaint and scale 10: The worst pain/complaint imaginable).

The effect of ergonomic exercise on musculoskeletal pain

Table IV. explains the results of the SPSS test, namely the results of the paired t-test analysis which shows a t-value of 17.12 (df = 84) with a p-value of 0.000 (p <0.05), which means there is a significant decrease between the pain scale before and after being given ergonomic exercise intervention.

Table 1. Demographic Characteristics of Respondents (n=85)

	f	(%)
Gender		
Male	71	83.5
Female	14	16.5
Age		
Early adulthood (18-40)	10	11.7
Middle adulthood (41-60)	63	74.1
Elderly (>60)	12	14.2
Education		
No schooling	3	3.5
Elementary school	31	36.5
Junior high school	22	25.9
Senior high school	29	34.1
Agricultural products		
Ornamental plants	67	78.8
Vegetables	18	21.2
Length of employment		

< 10 years	14	16.5
10–20 years	14	16.5
21–30 years	24	28.2
31–40 years	24	28.2
>40 years	9	10.6

Table 2. Distribution of Pain Locations

	f	(%)
Left Leg Pain	53	62.3
Right Leg Pain	50	58.8
Lower Back Pain	39	45.8
Left Arm Pain	34	40
Right Arm Pain	28	32.9
Shoulder Pain	24	28.2
Back Pain	23	27
Buttock Pain	17	20
Shoulder Pain	16	18.8

Table 3. Pain Scale Before and After Intervention

	Mean	Std. Deviation	Min-Max
Pre-Test	3.61	2.099	1 – 9
Post-Test	2.01	1.443	0 - 7

Table 4. The Effect of Ergonomic Exercise on Musculoskeletal Pain

	Mean	Std. Deviation	t	df	Sig. (2-tailed)
Pre & Post Test EEP	1.600	.862	17.115	84	.000

DISCUSSION

This study investigated the impact of an ergonomic exercise intervention on musculoskeletal disorder (MSD) complaints among farmers in Cihideung Village. The findings demonstrated a significant reduction in pain intensity following the intervention, with the mean pain score decreasing from 3.61 before the program to 2.01 after its completion (p = 0.000). Based on the Numeric Rating Scale (NRS), pre-intervention assessments indicated that participants reported pain levels ranging from 1 (mild discomfort) to 9 (severe pain). After the intervention, reported pain scores showed an improvement, ranging from 0 (no pain) to 7 (severe pain). These results are consistent with earlier studies suggesting that ergonomic exercise programs and structured physical activity are effective in alleviating MSD-related pain among individuals performing physically intensive work (3).

The demographic characteristics of respondents show that the majority of farmers are middle-aged (41-60 years old) with 21-40 years of work experience, which is a group vulnerable to MSDs due to the accumulation of physical workloads (15). This age group tends to be more susceptible to MSDs due to decreased muscle and joint elasticity with age (16). The most common complaints of pain were in the left leg (62.3%), lower back (45.8%), and left arm (40%), consistent with the literature stating that agricultural workers often experience pain in these areas due to activities such as lifting, bending, and standing for long periods of time (2).

The ergonomic exercise intervention in this study included muscle stretching exercises, muscle

strengthening exercises, and work posture education designed specifically for farmers. In the initial stage, muscle stretching exercises were performed to increase muscle flexibility and reduce stiffness (17,18), The second stage of muscle strengthening, especially in the back, shoulders, and legs, helps to increase muscle endurance in withstanding workloads (19), The third stage of work posture education was conducted to help respondents become more aware of the correct body position when farming, such as keeping the spine straight and avoiding bending over for too long.

The positive results of this intervention are supported by similar studies on pain reduction after intervention, which are supported by the theory that ergonomic exercises improve flexibility, muscle strength, and posture, thereby reducing pressure on joints and muscles (6,20,21).

The results of the paired t-test ($t = 17.12$; $p < 0.05$) reinforce similar findings in a quasi-experimental study by Kang et al, (2016) among Korean farmers, where ergonomic exercise reduced lower back pain by 35%. In addition, the active participation of respondents during the intervention was also a factor supporting the success of the ergonomics program's effectiveness.

CONCLUSION

This study found that ergonomics-based training was associated with a significant reduction in musculoskeletal disorder (MSD) complaints among farmers ($p < 0.05$). The intervention, which combined stretching activities, muscle-strengthening exercises, and education on proper working posture, helped improve flexibility, enhance muscular capacity, and increase awareness of ergonomic principles. These improvements may reduce excessive mechanical load on joints and muscles that commonly occurs during agricultural work. Overall, the findings support the use of structured, task-specific ergonomic training as both a preventive and supportive approach to promoting occupational health and reducing MSD risk among farmers.

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Author Contributions

NSW contributed to the study conception, research design, data collection, data analysis, and manuscript drafting. SR contributed to the development of the intervention program and data interpretation. ID provided methodological guidance and supervised the research process. RW contributed to data analysis and critical revision of the manuscript. ALP contributed to data validation, interpretation of results, and final manuscript review. All authors read and approved the final manuscript.

Conflict of Interest

The authors declare that there are no conflicts of interest associated with this study.

Data Availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request, in accordance with ethical standards and confidentiality requirements.

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